Microplastics in the Ocean

Kara Lavender Law, PhD
Sea Education Association
Woods Hole, MA
North Pacific Ocean, Oct. 2012
aka “Great Pacific Garbage Patch”

Images from Sea Education Association
Subtropical ocean
aka “Garbage Patches”

Images from Sea Education Association
Surface plankton net tow
Measuring microplastics

- Net mouth: 1 m x 0.5 m
- Net mesh: 335 μm
- Tow length: 1.8 km
- Ship speed: 2 knots
Western North Atlantic

> 6600 surface net tows from 1986-2010

26 million pieces per km$^2$

~ 130,000 pieces per km$^2$

Law et al., Science 2010
Eastern Pacific Ocean

> 2500 surface net tows from 2001–2012

Law et al., *ES&T* 2010
Spatiotemporal variability

Western North Atlantic

[Graph showing average plastic concentration and plastic discards in MSW (x 10^7 tons) over years 1985 to 2005.]

Eastern North Pacific

[Graph showing average plastic concentration (pieces per km²) over years 2002 to 2012.]

www.sea.edu
Wind-driven vertical mixing
(T. Kukulka, U. Delaware)
Physical characteristics of net-collected microplastics

81% HDPE
6% HDPE
Mass balance framework

Adapted from Cheshire et al. (UNEP, 2009)
Input of plastic waste from land

Plastic waste inputs from land into the ocean in 2010

The 192 countries with a coast bordering Atlantic, Pacific, and Indian oceans, Mediterranean and Black seas produced a total of 2.5 billion metric tons of solid waste. Of that, 275 million metric tons was plastic, and an estimated 8 million metric tons of mismanaged plastic waste entered the ocean in 2010.

Mitigation options:
- Reduce plastic in waste stream
- Improve solid waste management infrastructure
- Increase capture

Generated by 2 billion people within 50 km (30 miles) of the coast

Estimated mass of plastic waste floating at the ocean surface

Jambeck et al. (2015)
Global inventory of floating microplastics

96,000 to 236,000 metric tons
<< 8 million metric tons/year

Van Sebille et al. (2015)
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Trend in resin pellets
North Atlantic, 1986-2010

91% Decrease

Photo: H. Takada
Shipboard visual surveys
(D. Hyrenbach, Hawaii Pacific U.)

“Macrolebris” and seabirds
Summer 2008
Honolulu to San Francisco

Macro Debris Abundance from Neuston Tows (1000 pieces / squared km)

- None
- 0-50
- 50-100
- 100-250
- 250-500

Eastern Garbage Patch (Moore 2003)